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3,432,231

EXPOSURE CONTROL DEVICE

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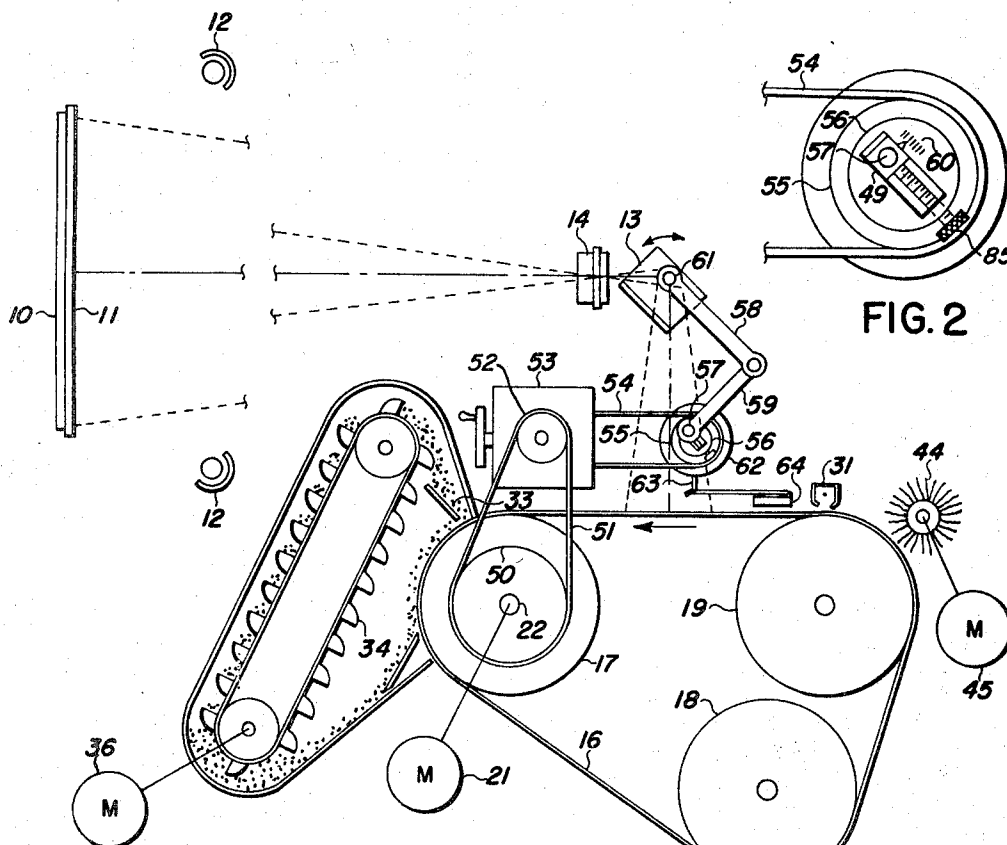


FIG. 1

FIG. 2

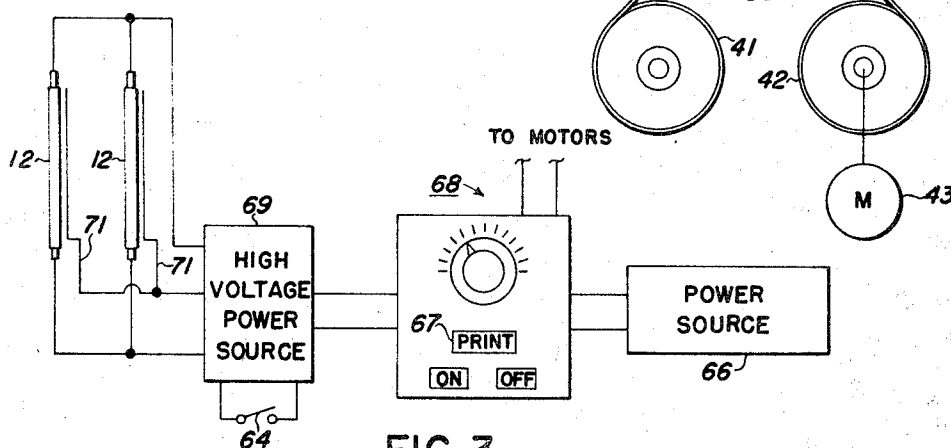


FIG. 3

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EXPOSURE CONTROL DEVICE

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4 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for creating a full frame image of a stationary original object onto a moving photoreceptive surface including a mirror oscillable in timed synchronous movement with the movement of the photoreceptive surface and a high intensity flash lamp for intermittently illuminating the stationary original object to flash a light pattern image thereof onto the photoreceptive surface.

This invention relates in general to image reproduction and, more particularly, to a method and apparatus for effecting multiple full frame exposures of a stationary original document onto a moving xerographic photoreceptor.

It is commonly known to full frame expose a stationary image original onto a stationary photoreceptor, such as photographic film, xerographic plate, diazo sheet, or the like. With stationary arrangements this is readily accomplished by an appropriate time control as a function of the available light intensity and the photographic sensitivity of the photoreceptor. However, in high speed duplicating systems, which employ a moving photoreceptor, it has not heretofore been possible to obtain full frame exposure of large size stationary documents, as, for example, 8½" x 11", without sacrificing quality in image resolution. This problem is even more acute in the case of low sensitivity photoreceptors as, for example, a xerographic plate requiring greater exposure intensity per unit of time than, for example, photographic film. The process of xerography in which a xerographic plate is employed is more fully disclosed in U.S. Patents 2,297,691 and 2,357,809 to Carlson.

Thus, to effect full frame exposure, it has been necessary to maintain the photoreceptor stationary during exposure. Most systems in use today for exposing from a stationary original onto a moving photoreceptor have resorted to complicated scanning mechanisms which, instead of full frame exposure, incrementally scan the original at a rate synchronized with the rate of photoreceptor movement. Such mechanisms are inefficient for producing a large number of high quality copies in a relatively short time.

It is, therefore, an object of this invention to provide for improved multiple full frame exposures of a stationary document original onto the surface of a moving photoreceptor.

Another object of this invention is to provide an efficient duplication process capable of continually reproducing high quality images of a planar stationary original rapidly onto a moving photoreceptor.

Still another object of this invention is to provide an apparatus for selectively exposing a stationary original in full frame onto a moving photoreceptor at a rate which varies inversely with the dimension of the original.

Yet still another object of this invention is to provide improved xerographic apparatus capable of reproducing multiple high resolution images rapidly and efficiently.

These and other objects and features of the invention will be apparent from the following description and from the drawings in which:

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FIG. 1 represents a partially schematic sectional view of xerographic copying apparatus embodying the invention;

FIG. 2 is an exploded view of the adjustable crank pin mechanism in FIG. 1; and

FIG. 3 is a schematic representation of exposure control according to the present invention.

Referring to FIG. 1 of the drawings, there is shown apparatus for reproducing a stationary planar original document 10 supported at the object plane on a transparent platen 11. Illumination is provided by two or more intermittently operable lamps 12 which are preferably of the flash type so as to permit high intensity illumination for a very brief time period. The intensity and time of illumination, of course, will vary with such factors as the ASA rating of the photoreceptor. The light pattern of the document is received through lens 14 by a displaceable roof mirror 13, operable as will be described below and reflected onto a recycling photoreceptor 16, such as a xerographic plate formed as an endless belt and moving in the direction indicated. The intermittent operation of lamps 12 is timed with the proper position of mirror 13, as will be more fully discussed hereinafter.

Photoreceptor 16, which could be non-recycled photographic film or the like, comprises for the purposes of the embodiment being described a recycling web of durable, flexible, and preferably electrically conductive material supporting on its outer surface a thin layer of photoconductive insulating material. Any suitable photoconductive insulating material known in connection with xerographic plates may be employed, such as, for example, a thin layer of vacuum deposited vitreous selenium. Selenium as well as other photoconductive insulating materials coated on a flexible support may be repeatedly bent around a radius of a few inches without cracking or flaking from the support and without removing xerographic effectiveness. Cylindrical rollers 17, 18, and 19 support photoreceptor 16 in the form of an endless flexible belt and motor 21 drives roller 17 about its shaft 22, whereby the belt is continuously advanced at a uniform constant rate.

As is conventional in the xerographic process, the photoconductor in the course of its movement is first charged by means of a corona charging device 31 supported adjacent to the belt surface to effect a uniform high potential thereon of the order of several hundred volts. After xerographic belt 16 moves past charging device 31, it advances planarily between rollers 17 and 19 to an exposure position for exposure to the pattern of light and shadow reflected from roof mirror 13 in accordance with the invention, as will be described below.

The exposure of the belt to the light image discharges the photoconductive layer in the areas struck by light so that there remains on the belt a latent electrostatic image configuration corresponding to the light image projected from the mirror 13. As the belt continues its movement, the electrostatic latent image passes through a developing station at which a two-component developing material 33, which may be of the type disclosed in U.S. Patents 2,618,552 and 2,638,416, is cascaded over the belt surface at it curves around roller 17. The developer material is handled by means of a bucket conveyor 34 driven by a motor 36. Thereafter, the powder image passes through an image transfer station at which the powder image is electrostatically transferred to a support surface web 37 by means of a second corona generating device 38.

The support surface to which the powder image is transferred may be paper, vellum, card stock, etc. Web 37 is supported by rollers 41 and 42, the latter being driven at a speed synchronous with the belt by a motor 43. The image may then be fixed to the support web by any

suitable means, such as heat fuser 40, as disclosed, for example, in Crumrine U.S. Patent 2,852,651. Instead of winding onto takeup roller 42, support web 37 may be passed directly to a cutter or the like by which the web is cut into severed lengths.

After transfer, that portion of the xerographic belt passes through a cleaning station at which its surface is brushed by a cleaning brush assembly 44, rotated by a motor 45, whereby residual developing material remaining on the belt is removed. This portion of the belt is then ready to receive another electrostatic charge from coronotron 31, permitting its to be indefinitely cycled through the xerographic stations just described.

In accordance with the invention, it is essential that the relative movement between the continuously moving photoreceptor belt 16 and the light rays reflected from the roof mirror 13 be kept at a minimum or substantially eliminated. In order to accomplish this, roof mirror 13 is oscillated about an axis through its apex at a rate at which the tangential velocity of the light rays reflected therefrom is substantially the same as the linear velocity of the belt in the plane of exposure. To achieve this effect there is secured to drive shaft 22 a pulley 50 for driving a belt 51 which, in turn, drives a pulley 52 connected to a variable speed drive mechanism 53. Any suitable variable speed drive mechanism may be used as, for example, the variable speed drive marketed by Graham Transmissions Inc., Menomonee Falls, Wis. Variable speed drive mechanism 53 drives still another belt 54 which, in turn, drives a pulley 55 to which is connected crank drive shaft 56 having a crank pin 57 mounted thereon. The radial distance of crank pin 57 from the center of crank drive shaft 56 is adjustable for a purpose to be described later. Crank pin 57 imparts an eccentric motion to crank arm 58 through connecting rod 59, thereby causing roof mirror 13 to be oscillated about shaft 61.

Also mounted on crank drive shaft 56 is a wheel 62 having a pin 63 secured to the periphery thereof. As pin 63 rotates, it actuates a switch 64 which closes the circuit for energizing flash lamps 12. In this manner, flash lamps 12 can be energized only when mirror 13 is in the proper position of its oscillating cycle.

As best shown in FIG. 2, the distance of crank pin 57 from the center of drive shaft 56 can be varied by turning externally threaded bolt 85 which engages an internally threaded block 49 carrying pin 57. By turning bolt 85, it is possible to select different arcs, as indicated on scale 60, through which mirror 13 oscillates. For each arc, a corresponding setting can be made to variable speed drive mechanism 53 so that the tangential velocity of the light rays reflected from roof mirror 13 onto moving photoreceptor belt 16 is maintained synchronized with the linear velocity of the belt in the plane of exposure. The advantage in being able to vary the oscillating arc of mirror 13 is apparent when considering the fact that as the dimension of the object in the exposure plane decreases, decreasing the arc for a given travel of the belt permits increased exposure cycles in the same unit length. More specifically, with a shorter arc it is possible to obtain more oscillations, i.e., more exposures, per displacement of photoreceptor 16. Thus, the number of copies available at any given speed of the photoreceptor 16 can be increased at a rate which varies inversely with the height of document 10.

Referring now to FIG. 3, there is shown in diagrammatic form a circuit for flashing lamps 12 at the proper time when oscillating mirror 13 is in position to initiate reflection of the pattern of light and shadow received from original 10. Flash lamps 12 and motors 21, 36, 43, and 45 are driven by a power supply 66 in accordance with a suitable controller 68. On the face of controller 68 is a dial 65 for preselecting the number of copies to be reproduced by the apparatus as well as a print button 67 to start the cycle in a manner well known by those skilled

in the art. In series with the circuit for flash lamps 12 is a stepped up high voltage power source 69 which is in series with a switch 64, the operation of which has already been discussed. When mirror 13 is positioned to reflect the image onto photoreceptor 16, switch 64 is actuated by the mirror drive assembly, thereby energizing lamps 12 through the actuation of trigger wires 71. Thus, lamps 12 will flash only when the mirror is in the proper position to expose. Moreover, the lamps will not expose the photoreceptor belt after the desired number of copies have been completed, as determined by the setting on dial 65. A suitable time delay permits motors 21, 43, 45 and 36 to remain operative until after the last exposed image is completely processed.

As disclosed by the description above, it is possible to obtain full frame exposure of an original on a moving photoreceptor without sacrificing quality and image resolution. Thus, by projecting the entire frame of the image onto the moving photoreceptor at the same speed at which the photoreceptor is moving and illuminating by flash lamps the image in timed relation to the movement of the mirror, multiple copies of an original may be made rapidly and efficiently. Moreover, the rate of copy reproduction can be increased proportionately as the size of the original document decreases merely by varying the appropriate settings on the apparatus. Furthermore, due to a built in safety mechanism, the high intensity flash lamps are illuminated only at such time as the oscillating mirror is ready for exposure thereby providing a more efficient use of the apparatus.

Although specific embodiments have been described herein, other components may be used with similar results. Thus, it is apparent that instead of an oscillating roof mirror it is possible to use two mirrors, one of which is fixed and the other of which is oscillated in the manner already described. Moreover, other photoreceptor materials may be substituted for the xerographic plate described. Other modifications will become apparent to those skilled in the art upon reading of this disclosure; these are intended to be encompassed within the scope of this invention.

What is claimed is:

1. Apparatus for intermittently exposing a full frame image of a stationary planar object onto a moving photoreceptor comprising:

- (a) a displaceable mirror optically positioned between an image of said planar object and said moving photoreceptor;
- (b) drive means connected to said mirror and synchronized with said moving photoreceptor for oscillating said mirror codirectionally and at a rate sufficient to impart a tangential velocity to a reflected image on said mirror equal to the linear velocity of said photoreceptor at the intersection thereof;
- (c) said drive means for oscillating said mirror including:
 - a presettable variable speed drive means;
 - a crank shaft driven by said drive means and having an adjustable crank pin secured thereto;
 - and
 - means to adjust said crank pin whereby the number of oscillations of said mirror per displacement of said photoreceptor can be varied while retaining the speed relationship therewith; and
- (d) means including a flash lamp and switch for selectively flash illuminating said object, during the interval said image and said photoreceptor are codirectionally moving together, for a predetermined number of times in timed relation to the oscillating cycle of said mirror.

2. Xerographic apparatus comprising:

- (a) at least two axially, tandemly arranged, spaced apart, parallel, cylindrical elements;
- (b) an endless flexible xerographic plate supported over

- said cylindrical elements and forming a planar position for exposure therebetween;
- (c) means for rotating at least one of said cylindrical elements to thereby move said endless xerographic plate at a constant rate;
- (d) charging means to charge the outer surface of said endless xerographic plate prior to exposure;
- (e) means displaced from said xerographic plate for supporting a planar original document to be reproduced;
- (f) optical means including a displaceable mirror for reflecting an image from a document on said last recited means onto the charged surface of said xerographic plate while said plate is passing through said exposure position;
- (g) drive means connected to said mirror and synchronized with the movement of said xerographic plate for oscillating said mirror to impart a tangential velocity to said reflected image equal to the velocity of said xerographic belt; and
- (h) means including a flash lamp and switch for selectively flash illuminating said object, during the interval said reflective image and said xerographic plate are moving at said equal tangential velocity, for a predetermined number of times in timed relation to the oscillating cycle of said mirror.
3. Xerographic apparatus comprising:
- (a) at least two axially, tandemly arranged, spaced apart, parallel, cylindrical elements;
- (b) an endless flexible xerographic plate supported over said cylindrical elements and forming a planar position for exposure therebetween;
- (c) means for rotating at least one of said cylindrical elements to thereby move said endless xerographic plate at a constant rate;
- (d) charging means to charge the outer surface of said endless xerographic plate prior to exposure;
- (e) means displaced from said xerographic plate for

- supporting a planar original document to be reproduced;
- (f) optical means including a displaceable mirror for reflecting an image from a document on said last recited means onto the charged surface of said xerographic plate while said plate is passing through said exposure position;
- (g) drive means connected to said mirror and synchronized with the movement of said xerographic plate for oscillating said mirror to impart a tangential velocity to said reflected image equal to the velocity of said xerographic belt;
- (h) means including a flash lamp and switch for selectively flash illuminating said object, during the interval said reflective image and said xerographic plate are moving at said equal tangential velocity, for a predetermined number of times in timed relation to the oscillating cycle of said mirror;
- (i) means for developing said xerographic plate;
- (j) means for transferring the developed pattern from said xerographic plate to copy sheet; and
- (k) means to clean the xerographic plate after transfer and before reuse thereof.
4. Xerographic apparatus according to claim 3 wherein said means for oscillating said mirror includes:
- (a) a variable speed drive means;
- (b) a crank shaft driven by said drive means and having an adjustable crank pin secured thereto; and
- (c) means to adjust said crank pin whereby the number of oscillations of said mirror per displacement of said photoreceptor can be varied while retaining the speed relationship therewith.

No references cited.

35 JOHN M. HORAN, *Primary Examiner*.

U.S. Cl. X.R.

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